RS232 control of external devices

Case study: how to use RS232 communication to control external devices?

One of the FAQ from NOVA users is:

I have a Kikusui PLZ164WA electronic load connected to the Autolab PGSTAT. Is it possible to control the settings of the load remotely?

RS232 control

The RS232 standard describes a communication method where information is sent bit by bit on a physical channel. Although the protocol itself is quite old, it is still present on scientific instrumentation. Since NOVA supports the RS232 communication, it is possible to use this protocol to integrate the control of external devices in the NOVA procedure.

Four dedicated commands are available in the **Measurement – External devices** group of the command browser (see Figure 1).

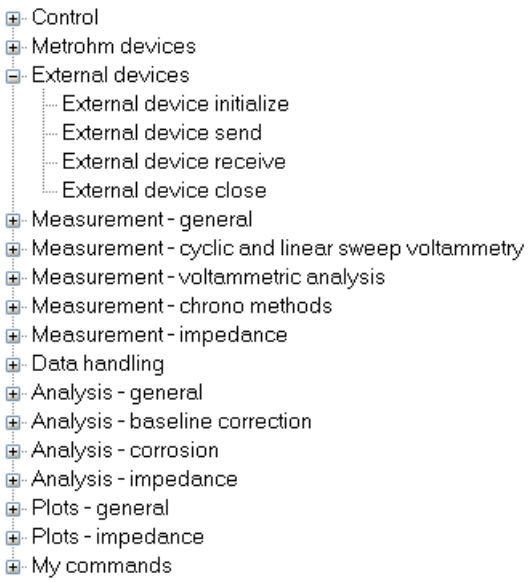

Figure 1 – The four commands used in RS232 communication in NOVA are located in the External devices group of commands

This technical note illustrates how to set up the RS232 control of the Kikusui PLZ164 or PLZ164WA electronic load in order to use this device in combination with the Autolab PGSTAT for energy storage devices characterization. The information provided in this technical note can however be used for other electronic loads or other devices, using the correct communication protocol.

Requirements

The following items are required for this technical note:

- **A Kikusui electronic load[1]:** the examples shown in this technical note apply to the following models: PLZ164 and PLZ164WA.
- **Serial port:** the host computer must have a serial port (COM port) available[2].
- **Null modem cable[3]:** a so called *null modem cable* is required for the control of the Kikusui electronic load.

Important note: this technical note assumes that the reader is familiar with the Kikusui PLZ164 or PLZ164WA electronic load. If this is not the case, the reader is invited to consult the user manual of the Kikusui electronic load[4]. The PLZ164 and the PLZ164WA have the following specifications in terms of current and voltage ranges:

- **Current ranges:** 330 mA (LOW), 3.3 A (MED) and 33 A (HIGH).
- **Voltage ranges:** 15 V (LOW) and 150 V (HIGH).

Hardware setup

Connect the cable to the serial port of the host computer and to the matching RS232C connector located on the back plane of the Kikusui electronic load (see Figure 2).

[1] Other devices can be controlled through a similar protocol. Refer to the user manual of the external device for specific information on the communication setup and the commands involved in the control of the device.
[2] A USB to serial adapter can also be used.
[3] This cable can be purchased in a computer store or online (www.farnell.com).
[4] http://www.kikusui.co.jp/kiku_manuals/P/PLZ_4W_E8_W_NOTES.PDF

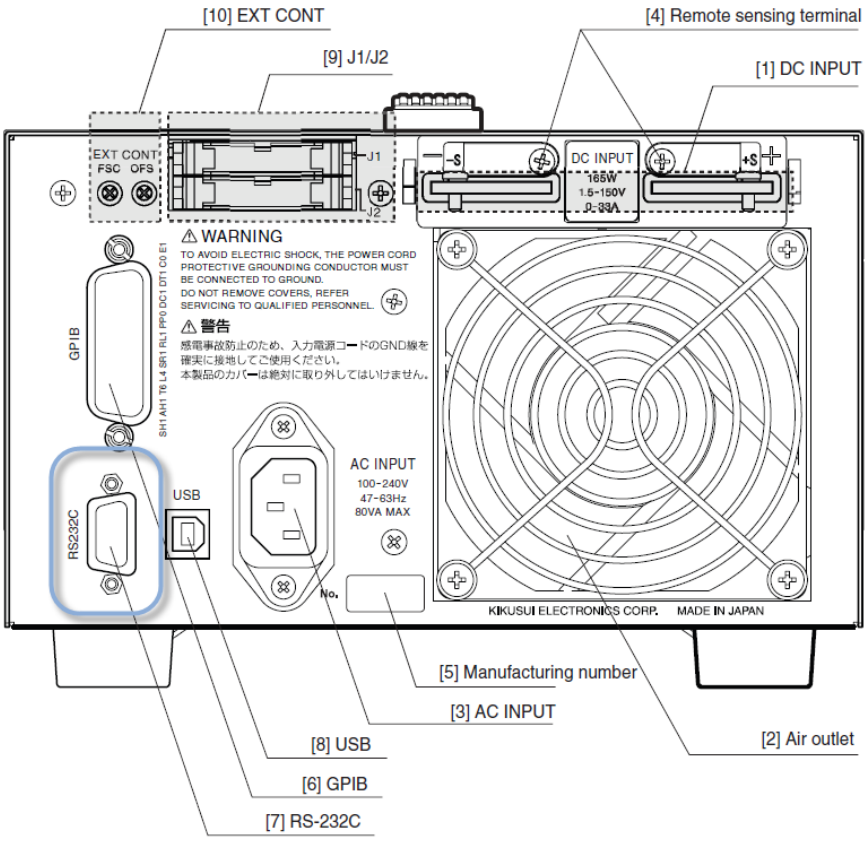

Figure 2 – Connect the null modem cable to the RS232C connector on the back plane of the Kikusui electronic load

Switch the electronic load ON and open the **Menu** by pressing the SHIFT and the MENU key at the same time on the front panel of the load (see Figure 3).

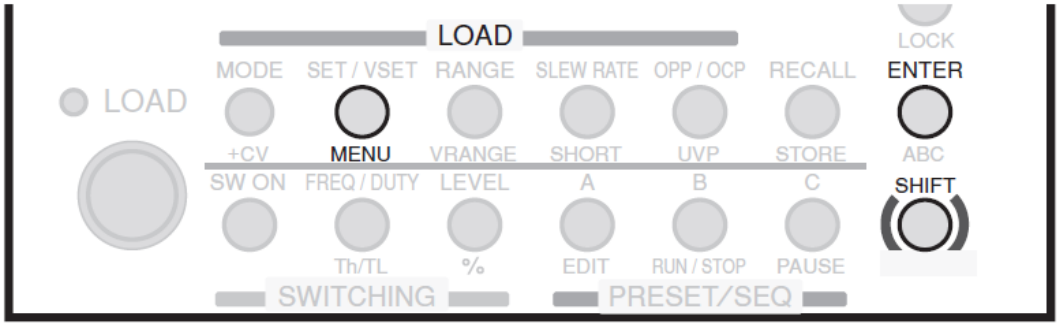

Figure 3 – Press the SHIFT key and the MENU key on the front panel of the load to open the configuration menu

Using the Arrow keys on the front panel of the load, navigate to the Configuration sub-menu. Press the ENTER key on the front panel to open the sub-menu. In the configuration sub-menu, open the Interface menu (see Figure 4).

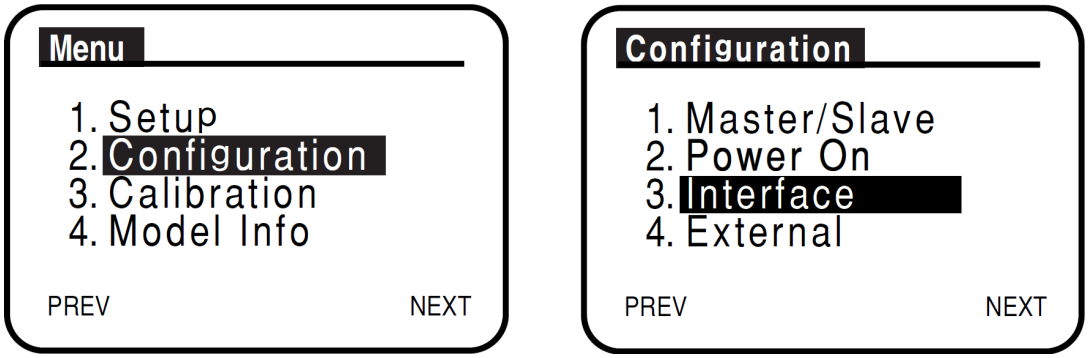

Figure 4 – Open the Configuration – Interface menu by using the Arrow and the ENTER keys on the front panel of the load

In the interface menu, rotate the rotary knob on the front panel of the load to set the Control parameter to RS232C. Set the other parameters to the following values:

- Baudrate: 19200bps
- Data,Stop: 8,2 (only the number of stop bits can be defined, the data format is fixed to 8 bits)
- Parity: NONE (this parameter is fixed)
- Ack: OFF

Press the SHIFT and the MENU keys on the front panel to close the Menu.

Switch off the load and switch it on again in order to validate the new settings.

NOVA setup

In the procedure setup, the commands required to control the electronic load can now be added to the procedure. Before the instrument can be controlled, the communication must be initialized.

Locate the *External device initialize* command in the External devices group of commands and add it to the procedure editor (see Figure 5).

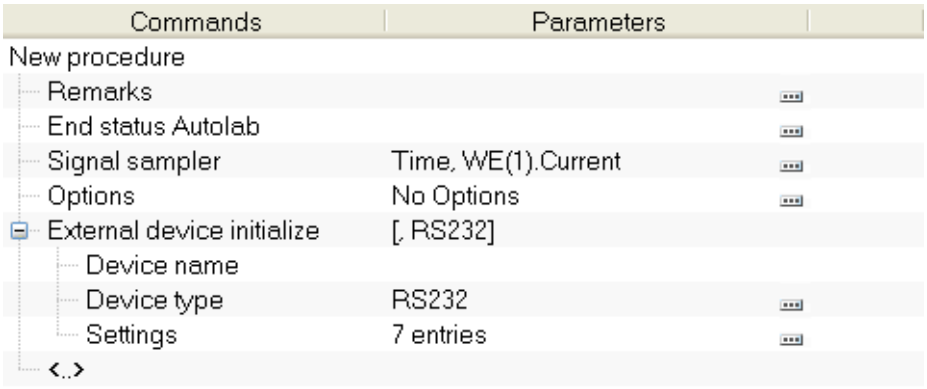

Figure 5 – Adding the External device initialize to the procedure editor

Set the Device name parameter to *Kikusui electronic load* for example, and click the button next to the Settings parameter in the procedure editor to open the configuration table for this command (see Figure 6).

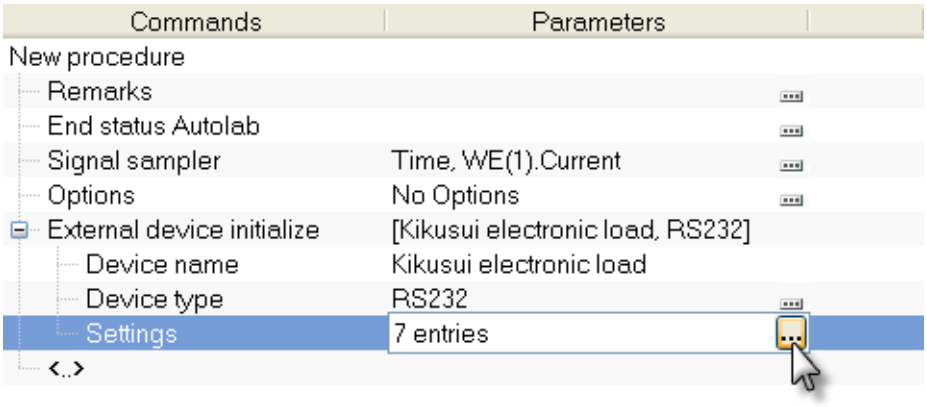

Figure 6 – Opening the settings table for the External device initialize command

A new window will be displayed (see Figure 7). In this interface, the settings of the RS232 communication for the external device can be defined.

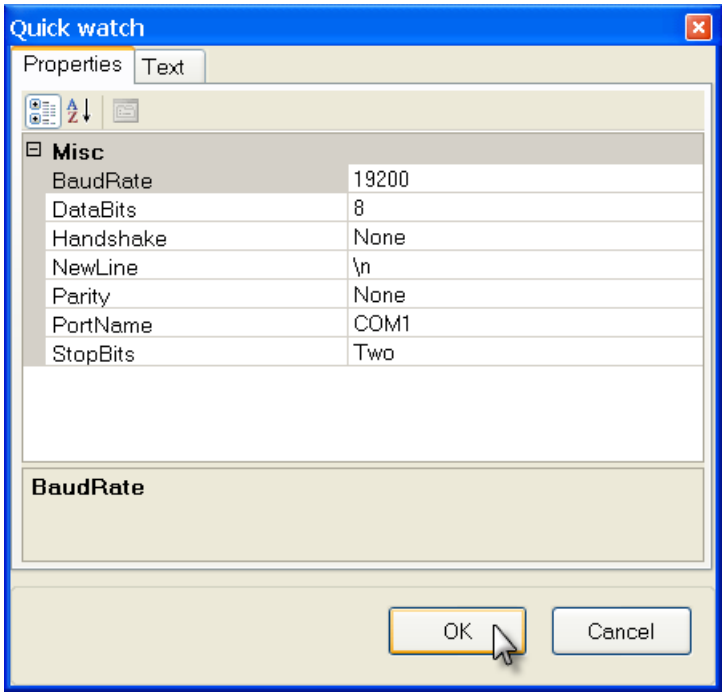

Figure 7 – The settings of the connection can be defined in the dedicated window

In this example, set the parameters to the following values (the parameters should match the settings defined on the load in the previous section):

- BaudRate: 19200
- DataBits: 8
- Handshake: None
- NewLine: \n
- Parity: None
- PortName: COM1[5]
- StopBits: Two

Click the OK button to validate the settings.

Note: make sure that the *External device close* command is used at the end of the procedure before starting the procedure. Each initialized connection must be closed using the corresponding *External device close* command (see Figure 8).

[5] The actual port name depends on the host computer configuration. Check the port number in the device manager of the computer (Control panel – System – Device Manager).

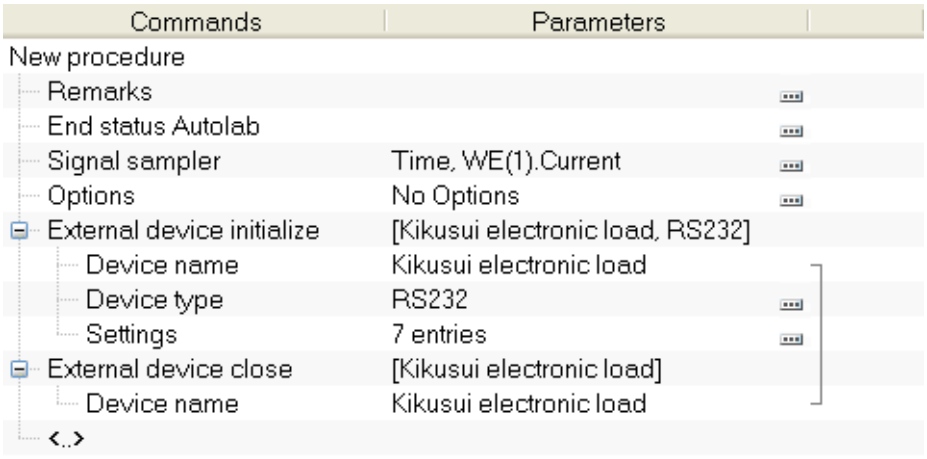

Figure 8 – Always close the connection to the external device at the end of the procedure using the *External device close* command

Sending instructions to the electronic load

The *External device send* command can be used to send an instruction to the external electronic load. To use this command, it must be added to the procedure editor (see Figure 9).

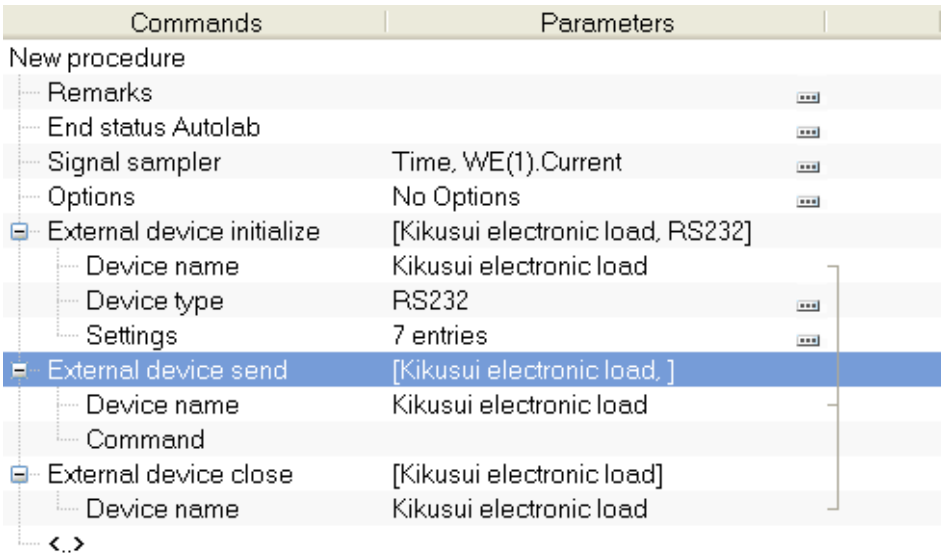

Figure 9 – Adding the External device send command to the procedure

Note: make sure that the Device name in the *External device send* command is the same as in the *External device initialize* command. The Device name parameter can be linked, as shown in Figure 9.

A number of control instructions can be sent to the electronic load. For a complete overview of these commands, please refer to the electronic load user manual[4].

In this technical note, a few examples will be used.

Mode of operation

Two modes of operation are commonly used in combination with the Autolab PGSTAT – Constant Voltage (CV) and Constant Current (CC). The mode of operation of the electronic load can be set by sending the following commands through the *External device send* command:

- Constant Voltage mode: FUNC CV
- Constant Current mode: FUNC CC

Note: command syntax is case sensitive.

For example, setting up the *External device send* command as shown in Figure 10 will force the electronic load to switch to constant current mode.

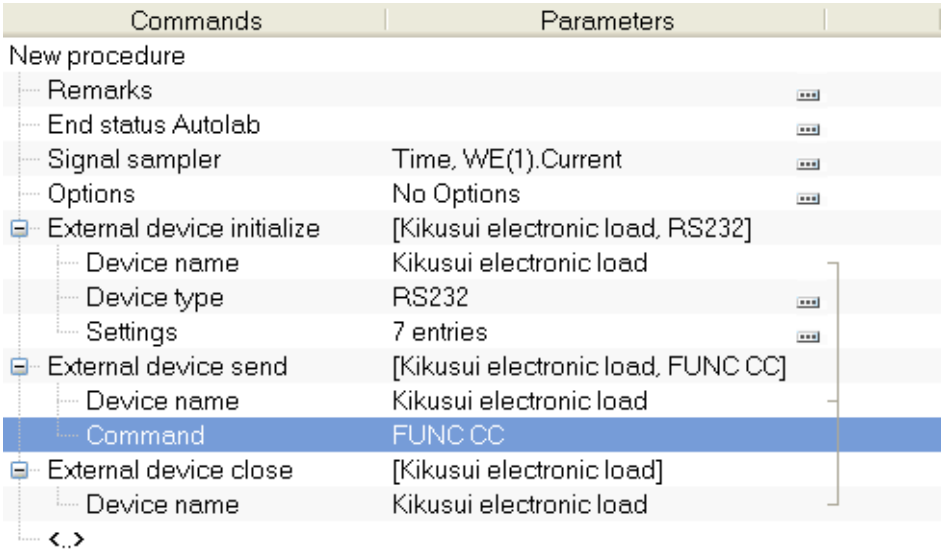

Figure 10 – Setting the load to Constant Current (CC) mode

Current range

Three current ranges are available on the Kikusui electronic load. The active current range can be set by sending the following commands through the *External device send* command:

- Low current range (330 mA): CURR:RANG LOW
- Medium current range (3.3 A): CURR:RANG MED
- High current range (33 A): CURR:RANG HIGH

For example, setting up the *External device send* command as shown in Figure 11 activates the high current range on the electronic load.

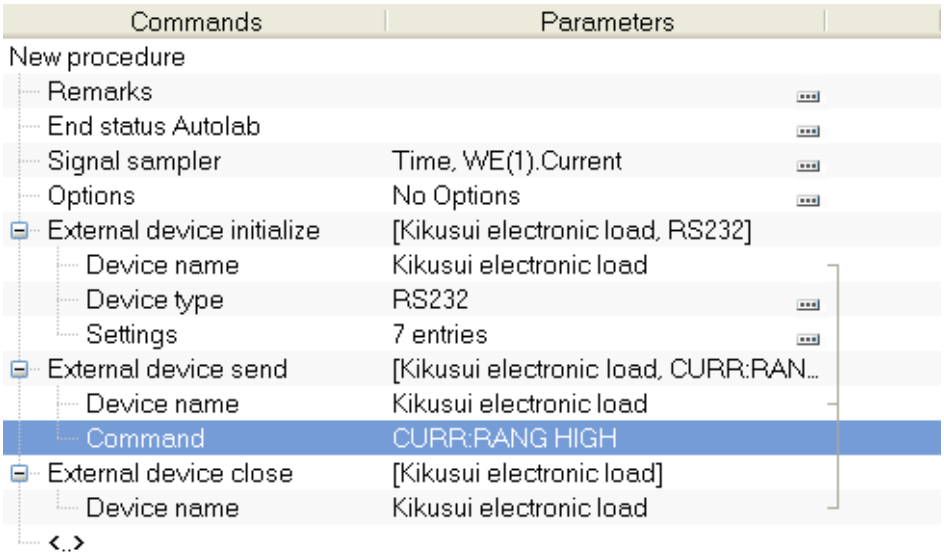

Figure 11 – Setting the load to High current range

Voltage range

Two voltage ranges are available on the Kikusui electronic load. The active voltage range can be set by sending the following commands through the *External device send* command:

- Low voltage range (15 V): VOLT:RANG LOW
- High voltage range (150 V): VOLT:RANG HIGH

For example, setting up the *External device send* command as shown in Figure 12 activates the high voltage range on the electronic load.

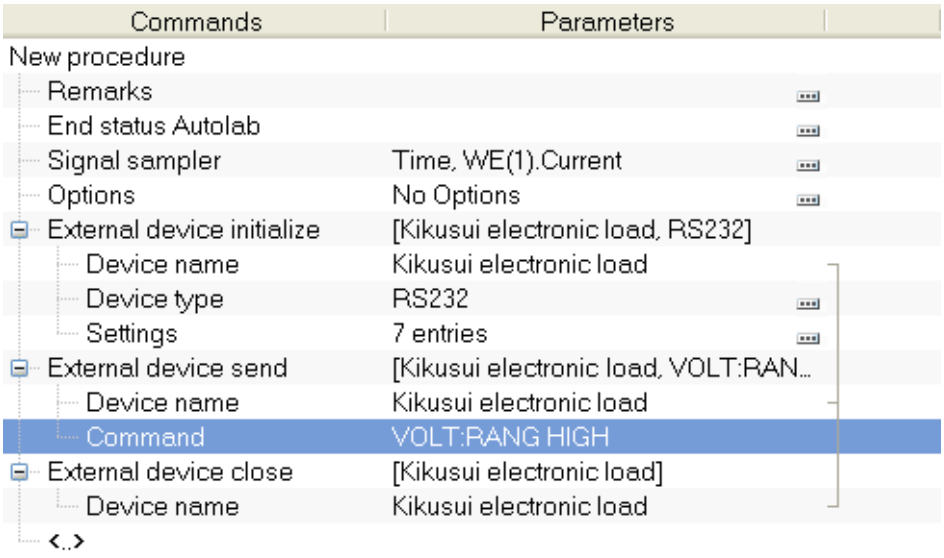

Figure 12 – Setting the load to High voltage range

Load switch

The electronic load can be switched on or off remotely by sending the following commands through the *External device send* command:

- Load On: **INP ON**
- Load Off: **INP OFF**

For example, setting up the *External device send* command as shown in Figure 13 switches the electronic load ON.

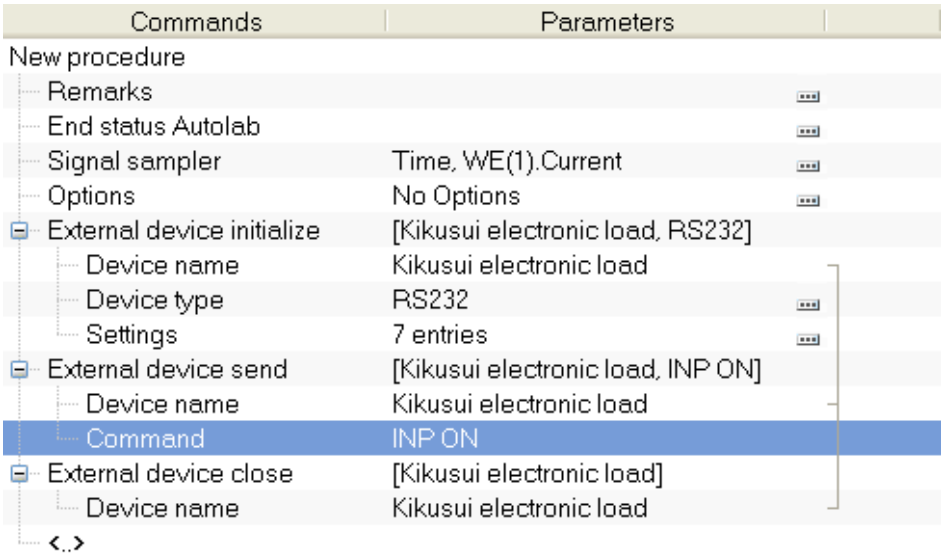

Figure 13 – Switching the electronic load ON

Receiving instructions from the electronic load

The *External device receive* command can be used to receive an instruction back from the external electronic load. The reply from the load is triggered by a query sent by the *External device send* command. For this reason, the *External device receive* command must be located after an *External device send* command in the procedure editor, as shown in Figure 14.

In this example, the *External device send* command sends the instruction ***IDN?** to the electronic load. This instruction is used to request the load to send back the instrument identification. The response of the load is received by Nova through the *External device receive* command and the string returned by the load is stored in the parameter **{0}**.

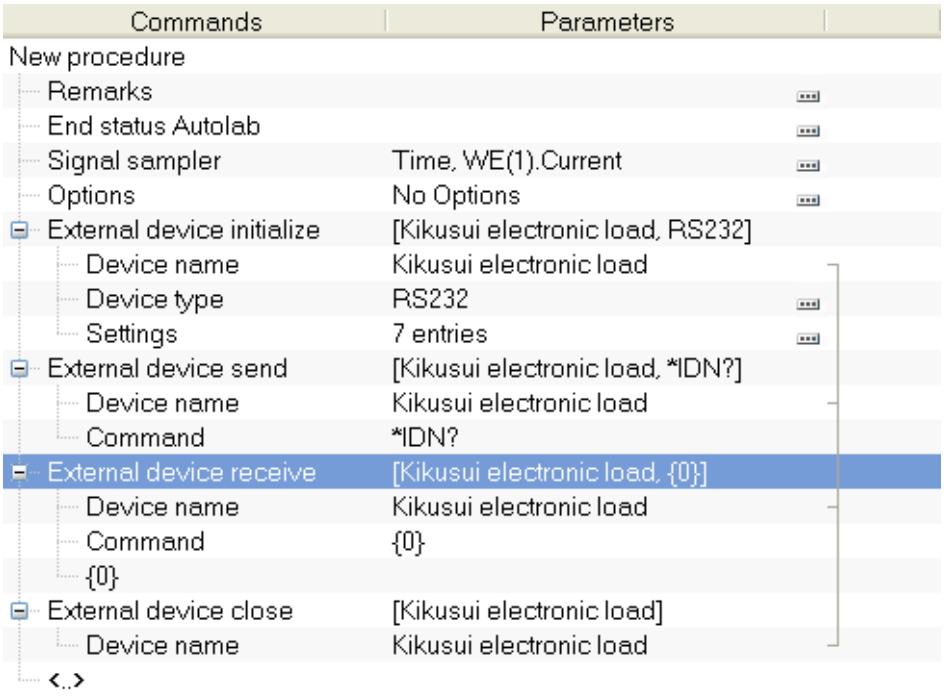

Figure 14 – Example of a External device receive command following a query sent to the load using the External device send command

In order to display the response of the electronic load to the user, it is possible to add a *Message box* command in the procedure as shown in Figure 15.

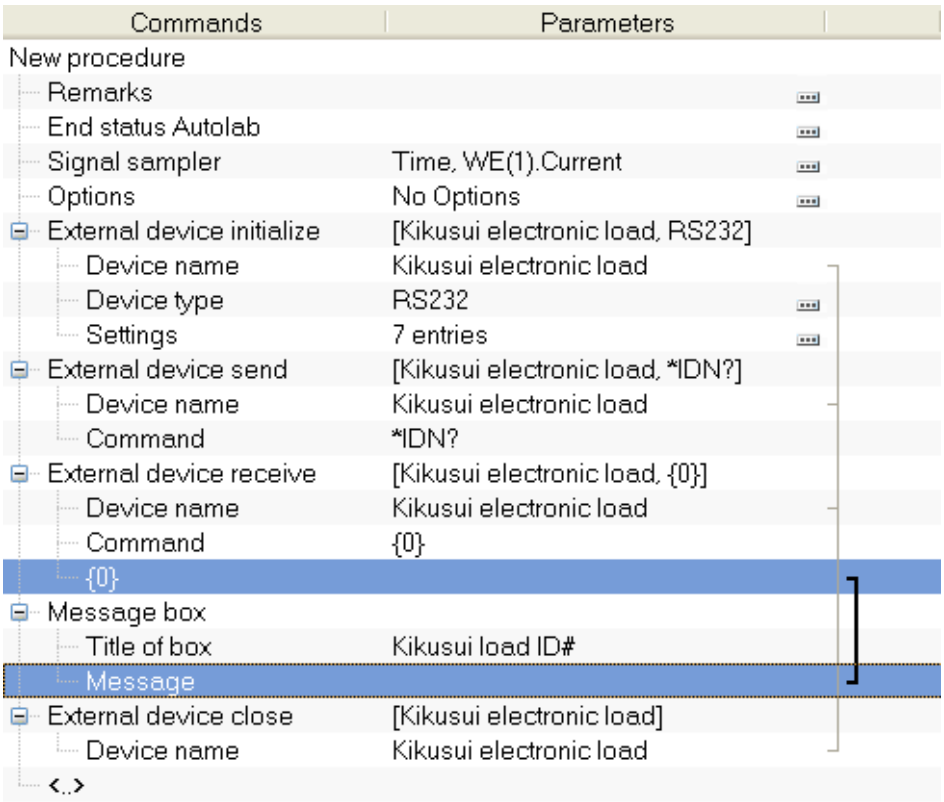

Figure 15 – Displaying the answer to the query in a message box

When this procedure is executed, the instrument identification number will be displayed in the message box (see Figure 16).

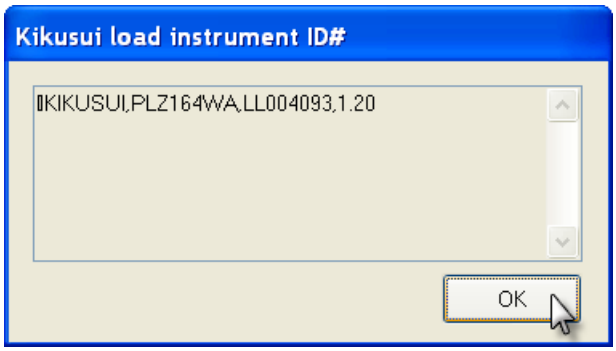

Figure 16 – The Instrument ID obtained from the instrument through the *External device receive* command is displayed in the message box

A number of query instructions can be sent to the electronic load through the *External device receive* command. For a complete overview of these commands, please refer to the electronic load user manual[4].

In this technical note, a few examples will be used.

Mode of operation?

It is possible to verify the mode of operation of the electronic load by using the following query in the *External device send* command:

- FUNC?

The reply from the instrument can be obtained from the *External device receive* command (see Figure 17). The response will be:

- CV: when the instrument is in Constant Voltage mode.
- CC: when the instrument is in Constant Current mode.

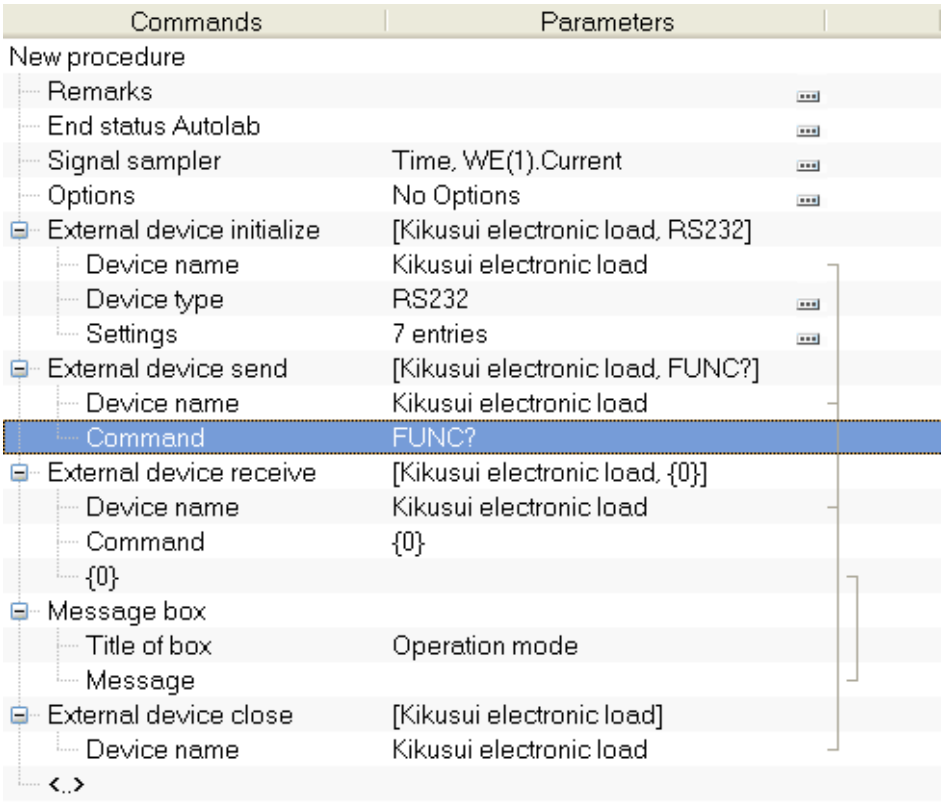

Figure 17 – Using the FUNC? query

Note: the Message box command can be used to display the operation mode of the load.

Current range?

It is possible to identify the active current range of the electronic load by using the following query in the *External device send* command:

- CURR:RANG?

The reply from the instrument can be obtained from the *External device receive* command (see Figure 18). The response will be:

- HIGH: when the high current range is active (33 A).
- MED: when the medium current range is active (3.3 A).
- LOW: when the low current range is active (330 mA).

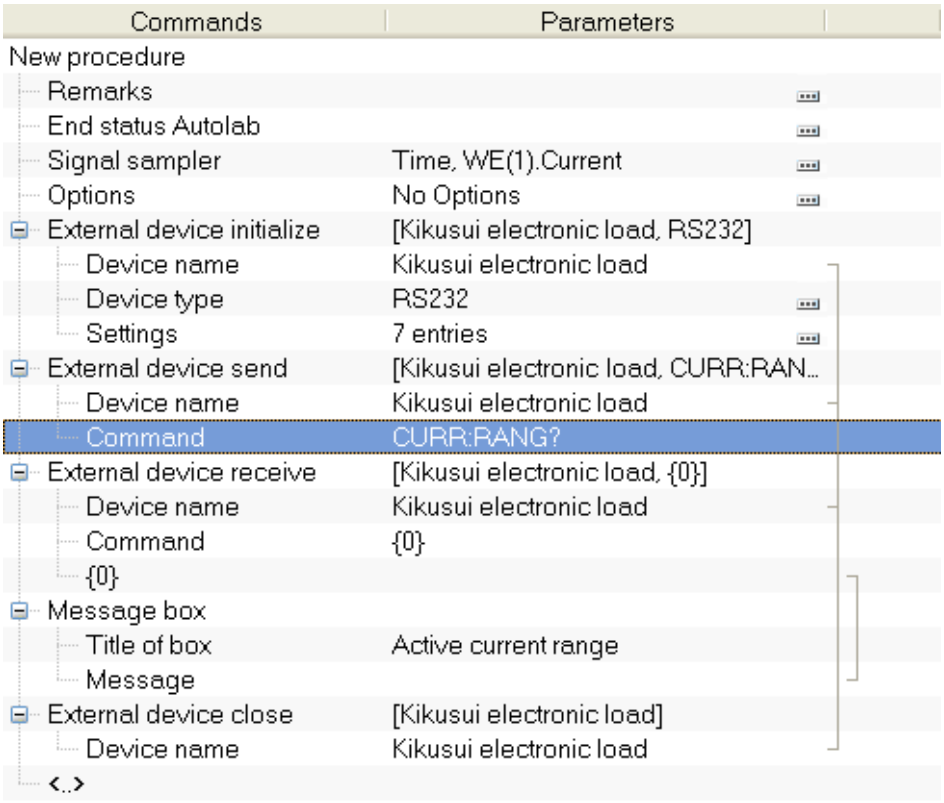

Figure 18 – Using the CURR:RANG? query

Note: the Message box command can be used to display the active current range of the load.

Voltage range?

It is possible to identify the active voltage range of the electronic load by using the following query in the *External device send* command:

- VOLT:RANG?

The reply from the instrument can be obtained from the *External device receive* command (see Figure 19). The response will be:

- HIGH: when the high voltage range is active (150 V).
- LOW: when the low voltage range is active (15 V).

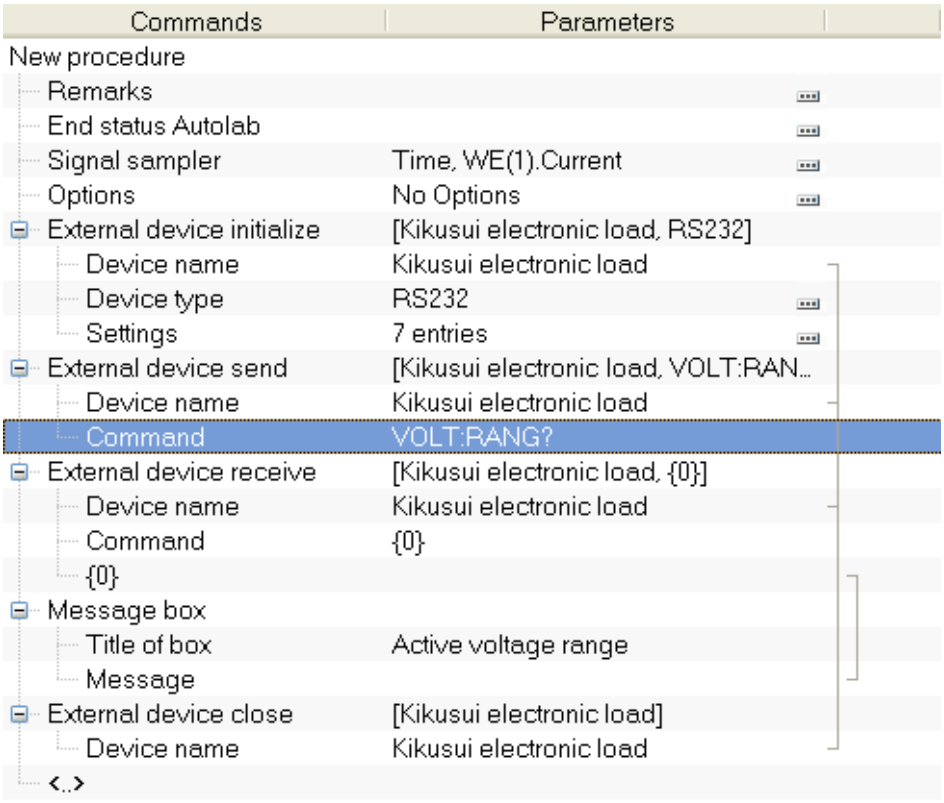

Figure 19 – Using the VOLT:RANG? query

Note: the Message box command can be used to display the active voltage range of the load.

Load switch?

It is possible to identify the status of the load switch of the electronic load by using the following query in the *External device send* command:

- INP?

The reply from the instrument can be obtained from the *External device receive* command (see Figure 20). The response will be:

- 1: when the load is ON.
- 0: when the load is OFF.

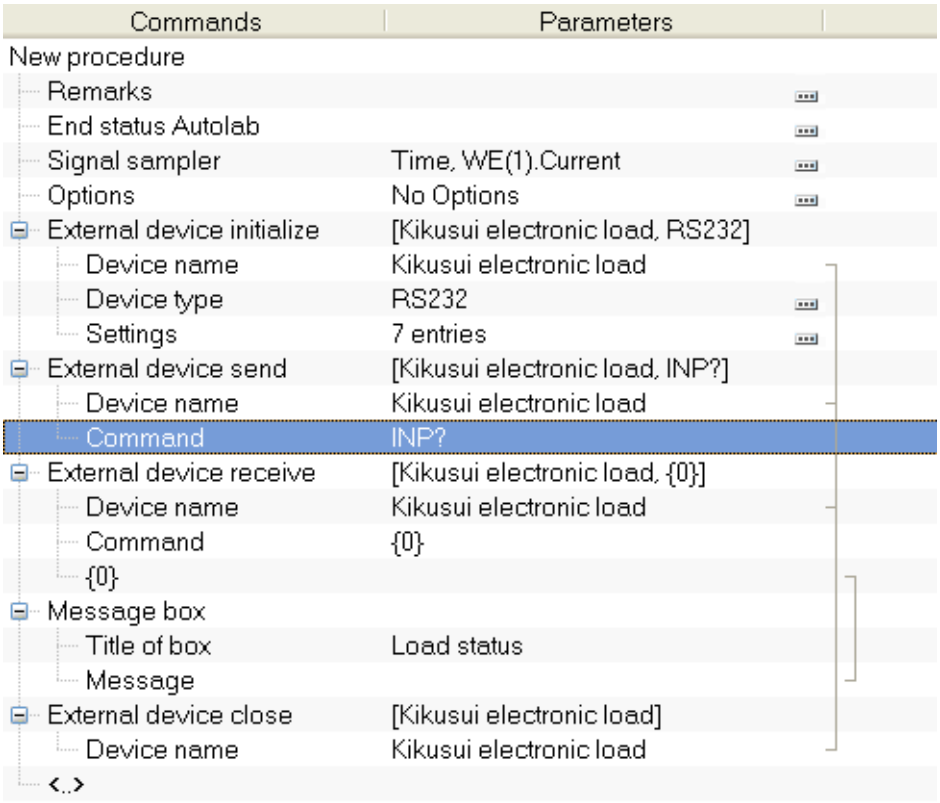

Figure 20 – Using the INP? Query

Note: the Message box command can be used to display the load switch status of the electronic load.

Conclusion

Using the commands located in the External devices group, it is possible to setup remote control of commonly used external devices like electronic loads, programmable power supplies, water bath thermostats, etc. The RS232 communication protocol is straightforward to setup and provides a convenient way to set specific instrument parameters during a Nova measurement.

Tip: debugging of the RS232 communication can be done quickly using the Hyperterminal software installed with Windows (see Figure 21).

Tip #2: do not forget that it is possible to save new commands in the My Commands group.

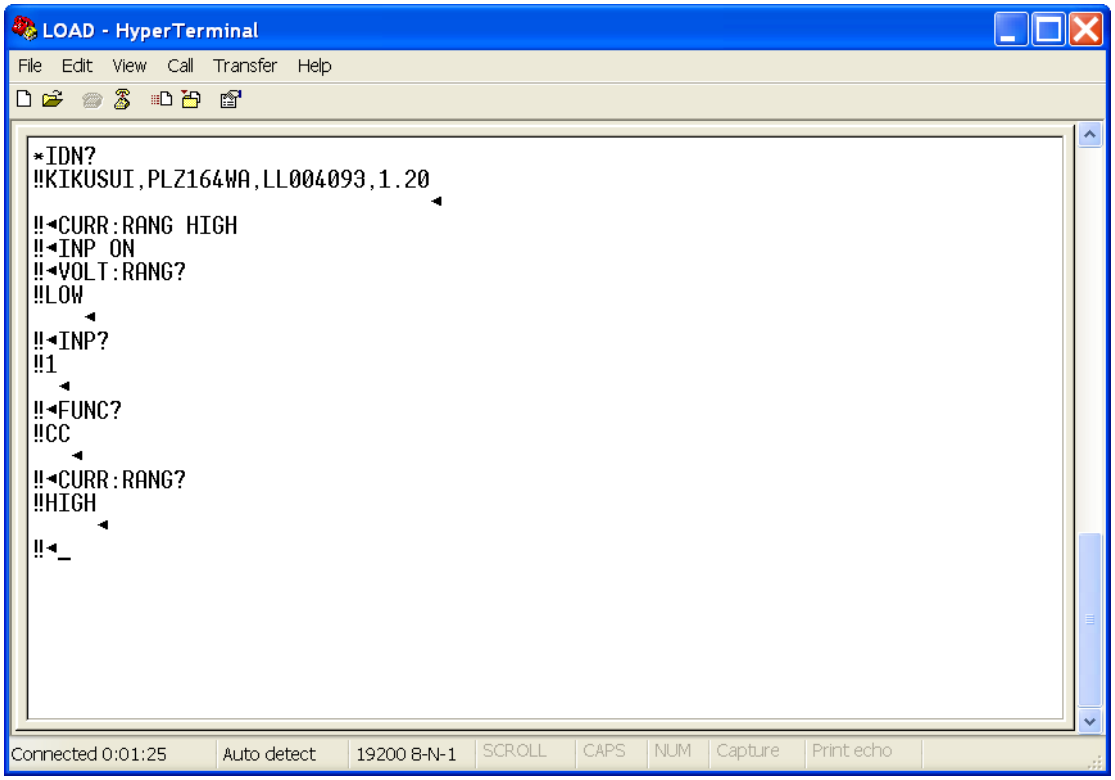

Figure 21 – The Hyperterminal application can be used to troubleshoot the RS232 communication protocol